

AA1675

005 21.10.2004 16:20:32

22

CLAIMS:

1. An apparatus comprising a compression ignition engine operable in a first, normal running mode and a second mode producing exhaust gas comprising an increased level of carbon monoxide (CO) relative to the first mode, means when in use to switch engine operation between the two modes and an exhaust system comprising a component comprising a substrate comprising a supported palladium (Pd) catalyst associated with at least one base metal promoter and an optionally supported platinum (Pt) catalyst associated with the Pd catalyst, which exhaust system component comprising an oxidation catalyst, a catalysed soot filter, a NO_x-trap, a four-way catalyst or a combination of a NO oxidation catalyst comprising the Pd catalyst, the associated at least one base metal promoter and the Pt catalyst and a filter downstream thereof.
2. An apparatus according to claim 1, wherein the engine is configured to produce >2000ppm CO when running in the second mode.
3. An apparatus according to claim 1 or 2, wherein the component substrate comprises a first layer comprising the Pt catalyst and a second layer overlying the first layer, which second layer comprising the supported Pd and the associated at least one base metal promoter.
4. An apparatus according to claim 1 or 2, wherein the component substrate comprises a single washcoat layer, which layer comprising the supported Pd, the associated at least one base metal promoter and the Pt catalyst, wherein the Pd catalyst and the Pt catalyst are each supported on a separate and distinct particulate support material.
5. An apparatus according to claim 1, 2, 3 or 4, wherein the exhaust system component comprises optionally supported Pt catalyst located downstream of the Pd catalyst.

AA1675/21Oct04

6. An apparatus according to any preceding claim, wherein the NO_x-trap or four-way catalyst comprises a NO_x absorber for absorbing NO_x in $\lambda > 1$ exhaust gas, wherein the NO_x absorber comprises at least one alkali metal, at least one alkaline earth metal or at least one rare earth metal or any two or more thereof.
7. An apparatus according to claim 6, wherein the at least one alkali metal is potassium or caesium.
8. An apparatus according to claim 6, wherein the at least one alkaline earth metal is calcium, barium or strontium.
9. An apparatus according to 6, wherein the at least one rare earth metal is lanthanum or yttrium.
10. An apparatus according to any preceding claim, including an exhaust gas recirculation valve and a circuit to recirculate a selected portion of the exhaust gas to an engine air intake.
11. An apparatus according to claim 10, wherein the recirculated exhaust gas is cooled prior to mixing with the engine intake air.
12. An apparatus according to any preceding claim, wherein control of the first and second running conditions is effected, in use, by engine control means.
13. An apparatus according to claim 12, wherein the engine control means comprises the engine control unit (ECU).
14. An apparatus according to any preceding claim, wherein the means for switching between the two modes switches between the first mode and the second mode when the Pt catalyst is <250°C.
15. An apparatus according to any preceding claim, wherein the Pd catalyst and the Pt catalyst are disposed on the same support material.

AA1675

007 21.10.2004 16:21:14

24

16. An apparatus according to any preceding claim, wherein the at least one base metal promoter is a reducible oxide or a basic metal or a mixture of any two or more thereof.

17. An apparatus according to claim 16, wherein the at least one reducible oxide is an oxide of manganese, iron, copper, tin, cobalt or cerium.

18. An apparatus according to claim 16 or 17, wherein the at least one reducible oxide is at least one of MnO₂, Mn₂O₃, Fe₂O₃, SnO₂, CuO, CoO and CeO₂.

19. An apparatus according to claim 16, 17 or 18, wherein the reducible oxide is dispersed on the support material.

20. An apparatus according to claim 16, 17 or 18, wherein the support material *per se* comprises particulate bulk reducible oxide.

21. An apparatus according to claim 16, wherein the at least one basic metal is an alkali metal, an alkaline earth metal or a lanthanide metal or any mixture, compound oxide or mixed oxide of any two or more thereof.

22. An apparatus according to claim 21, wherein the at least one alkaline earth metal is barium, magnesium, calcium, strontium.

23. An apparatus according to claim 21, wherein the at least one alkali metal is sodium, potassium or caesium.

24. An apparatus according to claim 21, wherein the at least one lanthanide metal is cerium, praseodymium or lanthanum.

25. An apparatus according to any preceding claim, wherein the or each support material comprises at least one of alumina, silica-alumina, ceria, magnesia, titania, zirconia, a zeolite or a mixture, composite oxide or mixed oxide of any two or more thereof.

AA1675/21Oct04

AA1675

25

26. An apparatus according to claim 25, wherein the support material comprises lanthanum-stabilised alumina.

27. An apparatus according to any of claims 1 to 24, wherein the support material comprises at least one basic metal.

28. An apparatus according to claim 27, wherein the at least one basic metal comprises at least one of zirconium, cerium, lanthanum, alumina, yttrium, praseodymium, barium and neodymium.

29. An apparatus according to claim 28, wherein the support material comprises ceria and zirconia, optionally in a weight ratio of from 5:95 to 95:5.

30. An apparatus according to any preceding claim, wherein the catalyst contains from 0.1 to 30%, optionally 0.5-15%, preferably 1-5%, by combined weight of Pt and Pd based on the total weight of the catalyst.

31. An apparatus according to any preceding claim, wherein the catalyst contains a weight ratio of from 95:5 to 10:90 Pd:Pt.

32. An apparatus according to any preceding claim, wherein the exhaust system comprises from 30-300g/ft³ Pd and from 30-300g/ft³ Pt.

33. An apparatus according to any preceding claim, wherein the catalyst contains from 0.1 to 10% Pt by weight based on the total weight of the catalyst and from 0.1 to 20% by weight based on the total weight of the catalyst.

34. An apparatus according to any preceding claim wherein the engine is a diesel engine, optionally a light-duty diesel engine.

35. A vehicle comprising an apparatus according to any preceding claim.

AA1675

009 21.10.2004 16:21:55

36. A process for operating an apparatus comprising a compression ignition engine and an exhaust system comprising a component comprising an oxidation catalyst, a catalysed soot filter, a NO_x-trap, a four-way catalyst or a combination of a NO oxidation catalyst and a filter downstream thereof, which component comprising a supported palladium (Pd) catalyst associated with at least one base metal promoter and an optionally supported platinum (Pt) catalyst associated with the Pd catalyst, which process comprising running the engine in a first, normal running mode and switching the engine to a second running mode producing exhaust gas comprising an increased level of carbon monoxide (CO) relative to the first mode wherein the CO is oxidised by the supported Pd catalyst during second mode operation, which switching step being effected when a value of at least one measurable parameter indicative of a condition of the engine is within or outside a pre-determined range.

37. A process according to claim 36, wherein the at least one measurable parameter is selected from the group consisting of exhaust gas temperature; catalyst bed temperature; mass flow of exhaust gas in the system; manifold vacuum; ignition timing; engine speed; throttle position (accelerator position); the lambda value of the exhaust gas; the quantity of fuel injected in the engine; the position of the exhaust gas recirculation (EGR) valve and thereby the amount of EGR; boost pressure; and engine coolant temperature.